MECHANICS' MAGAZINE,

AND

REGISTER OF INVENTIONS AND IMPROVEMENTS.

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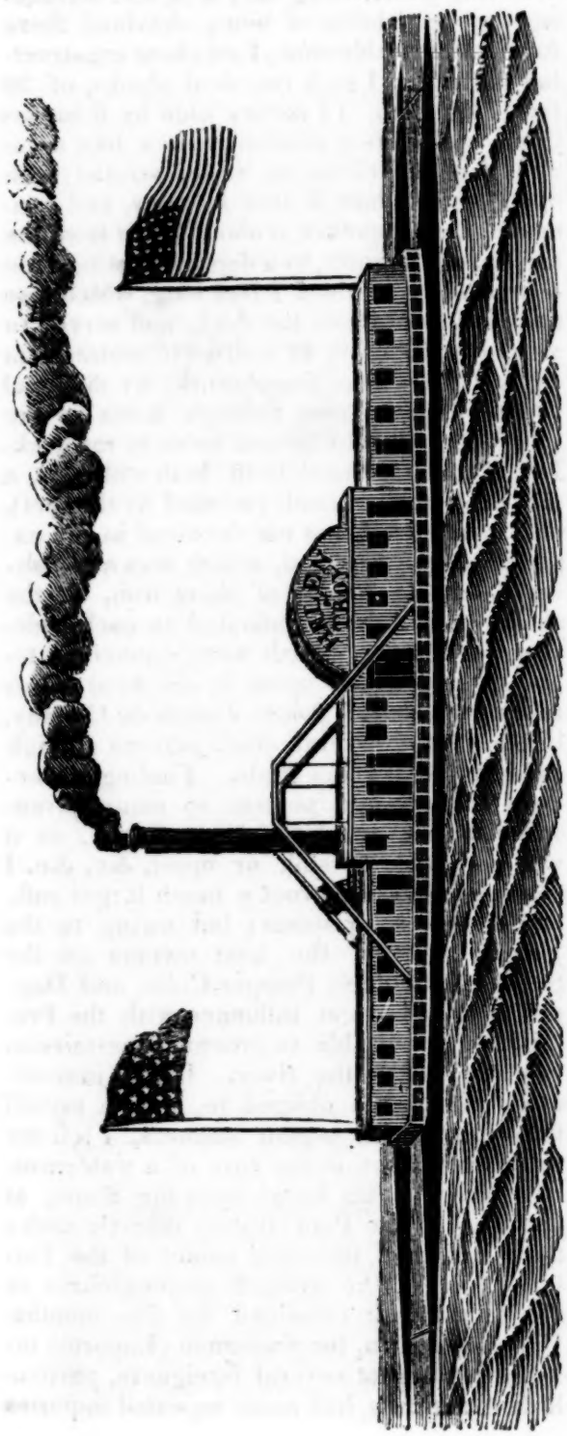
"All men naturally think themselves equally wise; and therefore, as any ship that sails faster than another is said, in sea phrase, to wrong it, so men are apt to think themselves wronged by those who, with better talents than they, or greater skill in their use, get beyond them."—HARTLIB.

NEW ERA OF STEAM POWER.



BURDEN'S BOAT.—This "wonder of the age" made its second trial on Wednesday last, June 10th. We have all along expressed our conviction that Mr. Burden has stated nothing that he will not accomplish; we think so still, and so does every practical man we have conversed with on the subject. But we do hope, that Mr. B. will not allow his anxiety to realize his promises interfere with his judgment, or in any way prevent his doing that which he has promised to accomplish, WELL. We insert the annexed engraving as a correct representation of it, and take this opportunity of introducing to the notice of our readers a condensed account of steam engines and their inventors, compiled from authentic sources. In a few days she will make her first trip to Troy.—[ED. MECH. MAG.]

Burden's Steamboat. By ARCHIMEDES. To the Editor of the Mechanics' Magazine, and Register of Inventions, &c.

SIR,—I wish, through the Magazine, to offer a brief apology for the disastrous consequences of my communication in a preceding number, respecting Harris' (patent-secured) twin-boat.

I solemnly protest, I had no disposition to wound the feelings, much less to disturb the intellect, of Mr. H. Had I anticipated that such would be the effect, or that it would cause the exclusion of interesting matter from a succession of pages of the Magazine, I certainly would not have written a word. It is some alleviation, however, of the trouble I feel on the occasion, that Mr. H. gives me credit for affording him "no little amusement," and that he absolves me of any criminal intention.

I must beg of Mr. H. to make a further

extension of his magnanimity, and pardon my stupidity in not at once discovering the dissimilarity of his and Mr. Fairman's twin-boat, when Mr. H. has not only described, but invites the reader to "imagine [he sees] a boat extremely long, very narrow, with a flat bottom, similar to river steamboats of the present day—very short, with fine tapering extremities, with the stem and stern posts in curvilinear shape, and both inclined in opposite directions, as in common vessels, but in very acute angles with the horizon. You have now," he tells the reader, "only to imagine this boat split into two equal parts longitudinally," &c. Now, what a numb-skull I must have been not to see the difference. 'Tis true, Mr. F.'s boat was *very narrow*, with a flat *bottom*, *similar to river* steamboats of the present day, &c. and it was split in two from stem to stern: so far they were alike; but Mr. H.'s imaginary boat was extremely long, whereas Mr. F.'s was only 35 feet. Mr. H.'s had fine tapering extremities, and I do not know that Mr. F.'s had any finery about it.

But, with great deference, I would beg leave to state that Mr. H. has misunderstood me in some trifles. I did not state, or, at any rate, I did not mean to state, that Mr. F. made his boat go 105 miles per hour; I only stated, that by Mr. F.'s making the alteration from straight to *swelled* sides, if Mr. H. will pardon the expression, the result was a gain in speed with the same power, from 4 to 6 miles per hour; that is, she would go but 4 miles before the *swell*, and she went 6 miles afterwards, with the same power. Mr. F. supposed that, as the water was thrown back from the wheel, by giving it a diverging passage, it would leave the boat more freely. [Perhaps he was wrong.] I would also inform Mr. H. that there are times when there is not a "six knot sailing breeze" in the sound, between the mouth of the Connecticut and New-London. Perhaps Mr. F. took such a time; at any rate, all the facts respecting his boat are susceptible of abundant proofs.

Mr. H. concludes with several statements, which he says I must in candor allow. To which I beg leave to reply, that as he has condemned Mr. Burden's boat, if he will have the lenity to respite the execution of his sentence until Mr. B. can satisfy me and the public by a fair experiment, I will never trouble him again, and will try to believe, and, at any rate, allow, whatsoever he pleases—and that he shall not hear again from

ARCHIMEDES.

Lansingburgh, May 27, 1834.

The Great American Steam-Raft of English Origin. By ALFRED CANNING. [From the London Mechanics' Magazine.]

SIR,—Having noticed in your Magazine for Saturday, 22d ult., an account of a raft propelled by steam, considered to be the invention of a Mr. Burden, in America, I think it due to myself to state, that in 1817 I conceived the idea of constructing a raft similar to that attributed to Mr. Burden, with this difference, that the bows of my floaters were to be considerably more elevated than those of Mr. Burden's raft. The following year, being in Paris, and foreseeing the probability of being detained there for a considerable time, I set about constructing my raft. I took two deal planks, of 30 feet long each, 12 inches wide by 6 inches thick, and having fashioned each like a canoe, I placed them on edge, parallel with each other, about 5 feet asunder, and connected them together at about 3 feet from the surface of the water, by a decking resting upon 4 stanchions, of about 7 feet long, which rose nearly 4 feet above the deck, and served to support a handrail, as well as to maintain in square the whole frame-work, by diagonal ropes, which passed through holes in the tops of the stanchions and holes in the deck. I tried this little model raft, both with oars, a sail, and paddle wheels (worked by the feet), and found that I was not deceived in my expectations of its speed, which was astonishing. I had a rudder of sheet iron, in the shape of a fish tail, adapted to each side-piece or floater, which were connected together and acted upon by diagonal cords and a cross-bar. Prince Joseph de Chimay, his sons, and several other persons of high rank, witnessed my trials. Finding it succeed so well, and possess so many advantages over every description of boat, as it was not liable to sink or upset, &c. &c. I determined to construct a much larger raft, and propel it by steam; but owing to the jealous spirit of the boat owners on the Seine, particularly Prosper-Colin, and Dagnet, who had great influence with the Prefect, I was not able to procure a permission to place it upon the river. Being immediately afterwards obliged to absent myself from Paris upon urgent business, I left my model raft afloat, in the care of a waterman, who lived in his barge upon the Seine, at the foot of the Pont Royal, directly under the windows of the royal palace of the Tuileries, one of the greatest thoroughfares in Paris, where it remained for five months. Upon my return, the waterman (Laporte) informed me that several foreigners, particularly Americans, had made repeated inquiries

respecting the nature of the raft, and that *two American gentlemen had made drawings of the raft;* and had observed, "that rafts constructed upon the same principle would suit well the lake navigation in the United States."

Should you, Sir, or any of your readers, feel desirous of seeing a sketch of my sail or steam raft, and further particulars respecting that, and four others which I constructed subsequently, having varied the dimensions of the floaters, and the substance of which they were composed, I will furnish them with pleasure. I remain, sir, your most obedient servant,

ALFRED CANNING.

Crown Coffee-House, Holborn, March 18, 1834.

[We shall be glad to hear again from Mr. Canning on the subject, with drawings, not only of his original model, but of his more matured plans of construction, and all illustrative particulars.—ED.]

NOTE.—Since the article in our present number, on the great American steam-raft was in type, we have received a letter from an esteemed correspondent, from which the following is an extract: "The velocity attained was in *still* water. The vessel draws only 7 *inches* water. They expect, with another that is completing, to perform *twenty-seven* miles an hour."

Account of Steam Engines and their Inventors.

[Compiled from authentic sources.]

The elegant toys of Hero, the beautiful experiments of Porta and Decaus, the modifications of the Greek machine by the unknown Italian, the practical merit of the "water-commanding engine," the ingenious ideas of Hautefeuille, and their masterly extension and developement by Papin, contain all the rudiments required for a perfect machine, waiting only to be touched by the wand of some mechanical magician, to form a structure of surpassing ingenuity and semi-omnipotent power.

The total neglect with which these individual schemes were regarded is not the least extraordinary circumstance in the history of the steam engine, and, above all, the oblivion which followed that of Lord Worcester, whose unconquerable perseverance, at the lowest ebb of his fortune, found means to carry his splendid ideas into practice. It appears improbable, but that his mechanism, whatever it was, was forced upon the attention of many parties connected with the draining of mines; and from the character of the Marquess, it is equally remote from belief that he would fetter the introduction of his invention into general use, by a high price asked for his permission to use it. The utter novelty of the nature and power of the agent, an ignorant and absurd idea of its danger, and the total want, probably, of any mechanical means, except that of mere strength of parts to guard against accidents, may have been the real causes of its neglect, and exclusion from practice.

Thirty years after Lord Worcester's death, a brilliant ray of improvement suddenly bursts into the history of the steam-engine, from the consummation of the labors of a Captain Thomas Savery, who had been silently employed in combining a mechanism, in which elastic vapor was the motive power.

Of the history of this distinguished man little is known. * * * * He is first presented to our observation as an author of a scheme for rowing ships in a calm, for which, after obtaining a patent, he in vain endeavored to procure the patronage of Government. "The trial of my scheme was unjustly thwarted by one man's humor," said Savery. "A regard to my duty, as well as place, will not permit me to give a biassed opinion," said the umpire. "But I have tried it," replied the projector, "on a small scale, and it answered completely." "So have we," said the servants of Government, "and in our trial it failed completely."

Savery afterwards remarked: "I was necessitated to write my book; for after I had racked my brains to find out that which a great many have spent several years in vain in the pursuit of, when I had brought it to a draught on paper, and found it approved by those commonly reputed ingenious, and receiving applause, with promises of great reward from court, if the thing would answer the end for which I proposed it; after I had, with great charge and several experiments, brought it to do beyond what I ever promised or expected myself, at last one man's humor, and more than a humor, totally obstructed the use of my engine, to my no small loss; but it is the nature of some people to decry all inventions, how serviceable soever to the public, that are not the product of their own brains."

He gave an account of it to secretary Trenchard. "A few days after, the secretary told me that the king had seen my proposals, and that I need not fear, for that the king had promised me a very considerable reward, and that I must go to the lords of the admiralty to put it in practice; but that *first* I must make a *model of it in a wherry*, which I *did*, and found it to answer my expectations. Then I showed a draft of it to the lords of the admiralty, who all seemed

to like it, and one amongst them was pleased to say that it was the best proposal of the kind he ever saw; so I was referred from them to the commissioners of the navy, who all seemed to like it, but told me that the model must be surveyed by Mr. D——, the surveyor of the navy, whose opinion I asked; but he was very reserved, and said, 'that a wherry was *too small a thing* to show it in, there being no working at a capstan in a wherry;' but he told me 'it was a thing of moment, and required some time to consider on; for should I,' said he, 'give a rash judgment against it, I should injure you; or for it, the charge of putting it in practice must prove a loss to the king, and endanger my employ.'"

After four months' consideration, Dummer gave his opinion against Savery. It was neither a new nor a practicable invention, being similar to one used at Chatham, in 1682, which was abandoned, and he designated, though rather disingenuously, the capstan and its trundle as "*clock-work;*" and although Savery "exhibited his wherry on the Thames, and thousands of people were eye-witnesses, and all people seemed to like it, the public newspapers speaking very largely of it, yet all to no purpose." (p. 18.) The inexorable lords of the admiralty were "so much altered that, from commending the thing, they would not hear one word in its defence." (p. 15.) Savery, notwithstanding, 'being informed by Sir Martin Beckman, the greatest engineer in the Christian world, that the thing was good, got a noble lord to show a draft of it to the king a second time, who ordered me," says Savery, "again to the admiralty, who never ordered me in before them, but, after waiting two or three days, the doorkeeper told me that my business lay before the *navy*. Upon which, next day, I desired a friend of mine to go with me to the navy office, that he, being a man of extraordinary judgment, and no less reputation, might be an evidence to what discourse might happen; but coming to the navy office, we found the board was rose. However, in the hall I found Mr. D——; I asked him whether any thing was come before the board concerning my business. 'No,' said he, 'not since the objections sent to the lords of the admiralty;' on which he could not but fall into an argument. I asked him some questions in relation to his objections, and in a very little time we had a great puther about superambient air and water. I found that my sailor ran himself fast aground, as men commonly do when out of their knowledge; this, indeed, made me pity him again, although I was willing to come at the plain truth of the matter, and asked him whether or no he could not bring one hundred and fifty men to work at this engine, he answered yes; then, said I, will they not have as much power to give a ship motion as one hundred and fifty men would have on shore, at a hawser fastened to the ship; this he likewise answered in the affirmative. Then, said I, it will do more than oars, or any thing but a gale of wind, and fully answer my proposals. Well, said he, with a smile, and putting off his hat as taking leave, 'We are all submission to the lords of the admiralty.'

"Not long after, a friend of mine met a commissioner of the navy, and my friend, being perfectly acquainted with my contrivance, asked the commissioner why it was not put in use by them? The gentleman offered several objections, which were, by sound reason, fully answered by my friend, that he had only this hole to creep out at. 'Sir,' said he, 'have we not a parcel of ingenious gentlemen at the board?' 'Yes,' said my friend, 'I hope so, or five hundred pounds per annum is paid them to a fine purpose.' 'Is not Mr. D——,' said the commissioner, 'one of them, and an ingenious man?' 'I hope so,' continued my friend. 'Then,' said he, 'what have interloping people, that have no concern with us, to pretend to contrive or invent any thing for us?'"

Savery, whose bluntness, probably, was no recommendation to his application, has several flings at the "boards," and his statement is wound up by a dexterous one at the contents of courtly Dummer's wig. "Whoever is angry with truth for appearing in mean language, may as well be angry with a wise and honest man for his plain habit; for, indeed, it is as common for lies and nonsense to be disguised by a jingle of words, as a blockhead to be hid by abundance of peruke."—[Navigation Improved, p. 33.]

In the pamphlet in which Savery appeals from their judgment to that of the public, he pays less attention to the reasons urged against its novelty, as well as practicability, than they were fairly entitled to receive.* In his resentment he says, that "not a tittle will he disclose of two other inventions of his until he has justice done him on account

* *Navigation Improved*, or the art of rowing ships of all rates, in calms, with a more easy, swift, and steady motion than oars can, by *Tho. Savery*, gent. London, 1698. In 1693 a M. Duquet made several experiments at Marseilles, at the expense of the King of France, to navigate a vessel by revolving paddles, or wheels, instead of oars. The results of these trials were very satisfactory, and strongly directed the attention of philosophers, as well as mechanics, to the practicability of this application of water-wheels.—[Machines Approuvees, tome i. p. 173.]

of his rowing engine." The first of these was "a gin of fourteen inches square, portable by one man, and by which one man may lift the largest cannon into her carriage." The second contrivance was a method whereby he could fight any ship, "using charge and discharge as often as six do now, and to as much purpose, without any manner of incommodation, more than by the common way, so that one half of the men need not be exposed that now are, and the rest may be kept as a reserve for boarding; the benefit of this I leave to the ingenious sailor."*

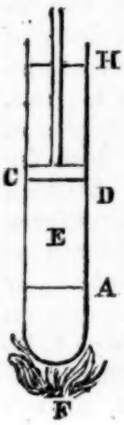
The enthusiasm of the projector was softened in Captain Savery by the experience of a practical mechanic; and he early appears to have acquired that personal consideration which usually follows a man of genius and enterprize, when his habits are those of a man of business.

At the first announcement of his machine for raising water, he had so matured his ideas, and was so well versed in the nature and power of the motive agent, that his masterly combination has left but minor objects for improvement to succeeding engineers. His mode also of introducing his invention to the notice of the public was totally different from that which had been followed by former projectors. They enveloped every thing in mystery, and endeavored to attract attention by exaggerated statements of power or economy. His first step was to explain to every one the principles, as well as construction, of his apparatus: he showed why it was a cheaper power than that of horses or men; and he invited practical men to judge for themselves of the value of his assertions and statements, by an inspection of the machine itself in operation.

The influence of the court was at this period considered to be essential to the success of any speculation which required the aid of a monopoly. The profits might be diminished or overthrown by the obstacles which avarice and intrigue could then interpose in that quarter to its further progress; and from this circumstance, considerable importance was attached to having the countenance of those in power to any project in which the pecuniary risk required to be extensive; and Captain Savery might be said to be conforming to an almost common practice, when he exhibited a working model of his fire engine before King William, at Hampton court. That monarch, who himself had a mechanical turn, was so pleased with its ingenious construction and effective action, that he took a warm interest in its success, and permitted its author to inscribe to him the account which he published of his contrivance, under the title of "The Miner's Friend."

The great fame of the Royal Society, then adorned by the presidency of Sir Isaac Newton, made its opinion to be listened to with profound respect in matters of science and mechanics. To that body also Captain Savery carried his invention; and in their transactions for that year is a record of his successful experiment, made in their apartment, and a view and description of the machine forms the subject of an engraving in their annual volume.

For more perfectly illustrating the mode in which steam operates, we will suppose the vessel, represented in the following figure, to be filled with water up to the line A, and the space E occupied with air, and having a plug or piston fitting it at C, and an aperture at D; now, if the aperture D be closed, and heat applied to the water, as at F, steam will be generated, and by its expansive force will raise the piston C upwards; then, if the heat be withdrawn, and the vessel suddenly cooled, condensation will take place, the steam, reassuming the form of water, will again occupy the space below the line A, and the piston C will re-



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* Sir Isaac Newton, in a report (dated Leicesterfield, January 27, 1718,) which he made to the government, on the practicability of an invention for measuring a ship's way at sea, mentions Savery as the *inventor* of this machine, and notices another of his contrivances. "Mr. Savery, who invented the raising of water by fire, told me about six years ago, that he had invented an instrument to measure the distance sailed, and by his description that instrument was much like this, (the one submitted for his opinion,) the sea water driving round the lowest and swiftest wheel thereof, and that wheel driving round other wheels, the highest and lowest of which turn about an index to show the length of the way sailed."

Savery complained of one of his inventions being neglected, from its resembling a mechanism with which he was unacquainted; but Savery's one, which is now mentioned, was itself only a copy from another described by Bourne, in his inventions as produced by a Humphrey Cole. De Saumarez complains, in his turn, of Savery's scheme being remembered by Sir Isaac only to get rid of his claim. The picture he draws of his pursuits and projects is an excellent likeness of a large but harmless class —can it be named?—of *simple schemers*.

"He was the son of De Saumarez, chaplain to Charles II.; although he was bred in Holland to learn commerce, he never applied himself to any trade or profession, but in *an easy and quiet enjoyment* of his small estate, in the island of Guernsey, he took his diversion in the experimental part of mathematics, his genius or inclination being that way for machines and inventions, wherein he spent about 22 years last past, confining himself to a retired sort of life, within his little laboratory; and of late he fixed his projects upon a particular invention, towards the improvement of navigation, which he could not bring forth to effect in the island, for want of able workmen; but he came to London on purpose, and he hath actually begun, and hopes, with the blessing of God, to bring it to some perfection."—[Memorial, p. 4.]

turn to its place. In this experiment the expansive force of the steam compressed the air in the space E, and forced the plug C upwards, we will suppose, to H; but C, in travelling to H, displaced so much of the atmosphere as occupied the tube from C to H; consequently, the portion so displaced will seek to resume its natural position, and when the force of the steam is withdrawn by condensation, the weight of that portion of the atmosphere will again return the plug C to its place; by which it is obvious that the raising of the plug was the direct action of the steam, and the returning its consequent action, or the action of the atmosphere, in consequence of its having been displaced by the force of the steam.

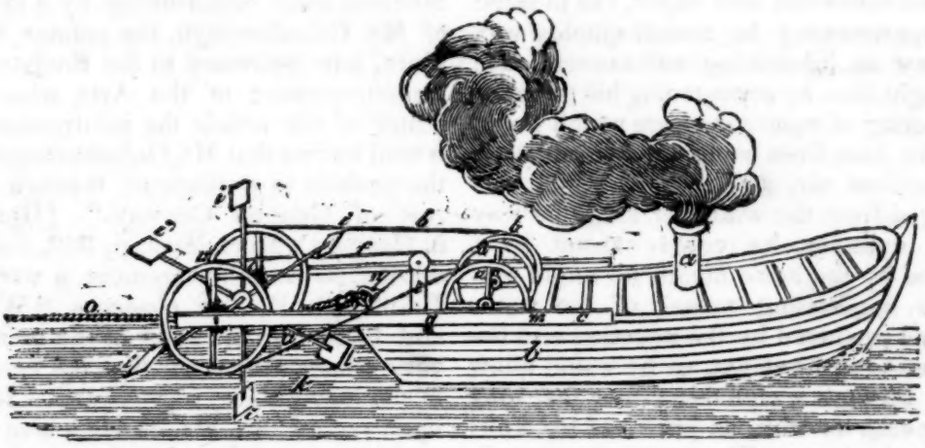
Again, if we suppose the plug to be in its first situation, as at C, and we open the aperture at D, and apply heat, the steam will rise into the space E, and expel the air through the aperture D, which being closed, and condensation caused, the space E will be left a vacuum, and the atmosphere seeking to occupy that space will force the plug C down to the line A; here the movement of the plug C was solely caused by the atmosphere exerting itself to regain the position whence it had been expelled by the force of the steam through D, and this effect is performed by the consequent power of steam alone.

It has been found by experiments, that the pressure of the atmosphere is equal to about 14 pounds weight upon every square inch, so that supposing the superficies of the aperture of the vessel, to contain one square inch, the power exerted by the steam in raising C to H will be tantamount to raising 14 pounds weight that height, together with the power necessary to overcome the friction and weight of the piston C, in the cylinder; and that the power exerted by the steam in expelling the atmosphere from the space E, and obtaining its consequent pressure to the raising of 14 pounds from A to C; and that the disposable power, obtained by the return of the piston from H, will, in the first instance, be equal to the raising of 14 pounds weight from C to H, less the amount of the friction of the piston C; and, in the second, will be equal to the raising of 14 pounds weight from C to A, less the amount of the friction as before. In both these instances the expansive or direct force of the steam has only been considered as equal to the displacing of the atmosphere, or what will be equal to 14 pounds pressure on each superficial inch; but if the piston C be loaded with any weight, the steam will, if urged with sufficient heat, raise it, always premising that the vessel is strong enough to resist the increased pressure. Suppose C to be loaded with 10 pounds of weight, the steam must be urged until its pressure is equal to 24 pounds, 10 pounds more, 14 pounds the pressure of the atmosphere on each square inch, and the resulting disposable force will be equal to 24 pounds more, the weight of C, less its friction returning to the place from where C was raised; so that, in this case, the pressure on the internal sides of the vessel, tending to burst it, will be equal to 10 pounds per square inch of the internal superfices, the remaining 14 pounds being counteracted by the pressure of the atmosphere on the external surface, which is equal to 14 pounds of the internal pressure. By this, it is evident that the direct force of steam may be increased without limits, whereas the resulting force or pressure of the atmosphere is manifestly bounded to 14 or 15 pounds on the square inch, according as its density varies.

A mode of applying the power of a steam-engine to navigate a vessel was suggested by Jonathan Hulls in 1737.* But the scheme, although a nearer approach to the present form of the steamboat, can neither be considered as the first suggestion for moving wheels by steam, nor any improvement on the idea which emanated from another—nor even any specimen of mechanical skill, for it is awkward, clumsy, and inartificial; but, as his claims have been put forth to a higher place than is here assigned him, they will be better understood by a reference to the engraving, (see following page,) and the description of it, which follows nearly in his own words. It is doubtful whether Hulls ever proceeded beyond printing a description of his project.

"*a*, chimney coming from the furnace; *b*, tow-boat; *c*, *c*, two pieces of timber framed together to carry the machine, *d*; *x*, *y*, *z*, three wheels on one axis to receive ropes, *s*, *t*, *u*; *t*, being rope that goes into cylinder; *m*, *n*, two wheels on same axis with the fans, *i*, *i*, *i*; *u*, is a rope going from wheel, *n*, to *z*; that, when the wheels, *x*, *y*, *z*, move forward, moves wheel, *n*, forward, and the fans along with it; *s*, a rope going from wheel, *m*, to the wheel *x*, so that when the wheels, *x*, *y*, *z*, move forward, the wheel, *m*, draws the rope, *s*, and raises the weight, *g*, at the same time as the wheel, *n*, brings the fans forward.

* A description and draught of a new-invented machine for carrying vessels or ships out of or into any harbor, port, or river, against wind or tide; or in a calm. London, 1737. It is a pamphlet, by no means scarce, containing forty-eight pages, about eight of which have any reference to his invention. Hulls took out a patent.



" When the weight, *g*, is so raised, while the wheels, *x*, *y*, *z*, are moving backward, the rope, *s*, gives way, and the power of the weight, *g*, brings the wheel, *m*, forward, and the fans with it, so that the fans always keep going forward, notwithstanding the wheels, *x*, *y*, *z*, move backwards and forwards as the piston moves up and down in the cylinder: *o*, *e*, teeth for a catch to drop in from the axis, and are so contrived that they catch in an alternate manner, to cause the fans to move always forward; for the wheel, *m*, by the power of the weight, *g*, is performing its office while the other wheel, *n*, goes back, in order to fetch another stroke. The weight, *g*, must contain but half the weight of the pillar of air pressing on the piston, because the weight is raised at the same time as the wheel, *n*, performs its office; so that it is, in effect, two machines acting alternately by the weight of one pillar, of such a diameter as the diameter of the cylinder is." Hulls, aware that objections might be urged against its want of originality, endeavors to anticipate them: " if it should be said," says he, " that this is not a new invention, because I make use of the same power to drive my machine that others have made use of to drive theirs for other purposes, I answer, the application of this power is no more than the application of any common and known instrument used in mechanism for new invented purposes."

It may, however, be observed, that he considers that it would not be practicable to place his apparatus on board of the ship which it is required should be moved—but that a separate vessel should be appropriated to its reception, and that this should be used as a tow-vessel; and he urges several economical reasons in favor of his *Tow-Boat*. The manner of converting the rectilineal motion of his piston into a rotary one, is very ingenious.*

Next in order we must place the experiments of the immortal James Watt.

From results, he saw that, in order to make the best use of steam, it was necessary that the *cylinder should always be as hot as the steam which entered it*. And also, that all the water that was formed by the condensed steam, and the injection-water likewise, should be cooled down to 100 degrees, or lower, where that was possible.

In looking to what had been done, or suggested by others, he had little to guide him in this inquiry. A rude help to his ingenuity might have been derived from some of the most common experiments with the air-pump; but at the moment when his sagacity had pointed out the direction of the path, his imagination did not enable him to follow it.

He had yielded to the difficulty, when, early in 1765, " in one of those moments when the heavenly spark of genius shone with brightness in his mind, the idea broke in upon him," that if a *communication were opened between a cylinder containing steam and another vessel which was exhausted of air, the steam would immediately rush into the empty vessel, and if that were kept very cool, by an injection or otherwise, the steam would continue to enter until the whole was condensed. And if an air-tight cover were placed on the cylinder, steam might be admitted to depress the piston in a vacuum instead of the atmosphere.* Admirable Invention!

When once the idea of separate condensation was started, minor improvements followed in quick succession. He imagined that the orifice for the piston-rod could be kept air-tight by means of a stuffing-box; and as it was obvious water could not be introduced to make the piston steam-tight, for if any of it found its way into a hot cylinder

* About this period three fire-engines were in operation in France, one at Fresne, near Conde; one at a coal mine at Sars, near Charleroi; a third at a lead mine near Namur.—[Gensanne, p. 300, vol ii.. Machines Approuvees.]

it would be converted into vapor, (as in some of his experiments,) he should employ wax and tallow as lubricating substances. He also thought that, by surrounding his cylinder with a casing of some substance which would prevent its heat from being abstracted by the circumambient air, and the air which was disengaged from the water, or found its way into the cylinder, he could extract by a pump, and by the same means he might employ the condensing vessel of the water which was produced by the injection and the condensation of the steam, or he would allow it to fall through a pipe thirty-four feet long into a pump or well, as practised by Newcomen and others. Thus, step by step, in the course of one or two days, in the eye of his mind, the exquisite conception was complete.

"About the time that Mr. Watt was engaged in bringing forward the improvement of the engine, it occurred to Mr. Gainsborough, the pastor of a dissenting congregation at Henley-upon-Thames, and brother to the painter of that name, that it would be a great improvement to condense the steam in a vessel distinct from the cylinder, where the vacuum was formed, and he undertook a set of experiments to apply the principle he had established, which he did by placing a small vessel by the side of the cylinder, which was to receive just so much steam from the boiler as would discharge the air and condensing water, in the same manner as was the practice from the cylinder itself, in the Newcomenian method—that is, by the snifting valve and sinking pipe. In this manner he used no more steam than was just necessary for that particular purpose, which, at the instant of discharging, was entirely uncommunicated with the main cylinder, so that the cylinder was kept constantly as hot as the steam could make it. Whether he closed the cylinder as Mr. Watt does, is uncertain; but his model succeeded so well, as to induce some of the Cornish adventurers to send their engineers to examine it; and their report was so favorable as to induce an intention of adopting it. This, however, was soon after Mr. Watt had his act of parliament passed for the extension of his term; and he had about the same time made proposals to the Cornish gentlemen to send his engine into that country. This necessarily brought on a competition, in which Mr. Watt suceeeded; but it was asserted by Mr. Gainsborough, that the mode of condensing out of the cylinder was communicated to Mr. Watt by the officious folly of an acquaintance, who was fully informed of what Mr. Gainsborough had in hand. This circumstance, as here related, receives some confirmation by a declaration of Mr. Gainsborough, the painter, to Mr. T. More, late secretary to the Society for the Encouragement of the Arts, who gave the writer of this article the information; and it is well known that Mr. Gainsborough opposed the petition to parliament through the interest of General Conway." [Hornblower, in Gregory's Mechanics, p. 362, vol ii., first edition.]—On this statement, a writer in the Edinburgh Review observes, "We believe and hope, for the sake of the memory of a very respectable man, that the conversation is not accurately represented. It remains upon record that Mr. T. More was examined as a witness on the trial of a cause of Bolton *vs.* Bull, in 1792, at which time Mr. Hornblower himself was also examined as a witness, but on the opposite side from Mr. More. Mr. M., on this occasion, was asked, whether he had read the specification of Mr. Watt's invention, and whether, in his opinion, it contained a disclosure of the principles of the steam-engine? To this question he answered, 'I am fully of opinion that it contains the principles entirely, clearly, and demonstratively.' He was then asked, 'Did you ever meet with the application of these principles before you knew of Mr. Watt's engine?' His answer was, 'I do declare I never saw the principles laid down in Mr. Watt's specification, either applied to the steam-engine previous to his taking it up, or ever read of any such thing whatever.' It is not easy to reconcile these two answers given by that gentleman on his oath, with the words that Mr. Hornblower has put into his mouth. Mr. Gainsborough's idea, whatever it was, was posterior by more than twenty years." (?) [P. 328, vol. xiii.]—We know not if the claim which is put forth in the above extract is the same as that alluded to by the late venerable Professor Jardine. "I happened," says he, "to be tutor to Dr. Roebuck's sons at that time (when Watt was at Kinneil); I had then the pleasure of seeing the experiments on a great scale, which were carrying on. This accidental circumstance, and this opportunity, connected me so much with what was going on, that when they were completed I was asked by Mr. Watt to go with him to Berwick, when he went to give in a specification of his invention before a Master in Chancery, previous to the obtaining of a patent. And many years afterwards, when a groundless and frivolous charge was brought against Mr. Watt, *by a person who claimed a share in the invention*, I was called to give evidence of what I knew of this in Chancery. It is needless to add, Mr. Watt was triumphantly victorious."

The failure of both Fitch and Rumsey to carry their schemes into practice, as it had previously done in another, settled the dispute as to priority of invention in America.

Oliver Evans, about the same period, had been maturing a plan for using steam of an elasticity ten times greater than that employed in the condensing and atmospheric engines. And his proposal was further remarkable, as embracing a device to propel waggons on common roads, by a steam-engine instead of horses. "But all united," says he, "in condemning the scheme, except two gentlemen, (one of whom was a projector himself,) and indeed one, who has the name of a celebrated engineer, continued to oppose them for a long time after they were fully in operation."

One of his adversaries was a Mr. Latrobe, who uniformly opposed steamboat projects, as well as those for steam carriages. Fifteen years after this period, and three years before they were finally established, (unfortunately for his reputation,) he printed a report against their practicability. We quote it as containing some *facts* respecting steam navigation. "After the American Revolution, a sort of mania began to prevail, which, indeed, has not yet entirely subsided, for impelling boats by steam-engines. Dr. Franklin proposed to force forward the boat by the immediate action of the steam upon the water. Many attempts to simplify the working of the engine, and more to employ a means of dispensing with the beam in converting the libratory into a rotary motion were made. For a short time a passage-boat, rowed by a steam-engine, was established between Bordentown and Philadelphia, but it was soon laid aside. The best and most powerful steam-engine which has been employed for this purpose, (excepting, perhaps, one constructed by Dr. Kinsey, with the performance of which I am not sufficiently acquainted,) belonged to a few gentlemen of New-York. It was made to act by way of experiment upon oars, upon paddles, and upon flutter wheels; nothing in the success of these experiments appeared to be sufficient compensation for the expense, and extreme inconvenience of the steam-engine in the vessel.

"There are, indeed, general objections to the use of the steam-engine for impelling boats, from which no particular mode of application can be free. These are—1st, the weight of the engine and the fuel; 2d, The large space it occupies; 3d, The tendency of its action to rack the vessel and render it leaky; 4th, The expense of maintenance; 5th, The irregularity of its motion, and the motion of the water in the boiler and cistern, and of the fuel vessel in rough water; 6th, The difficulty arising from the liability of the paddles or oars to break, if light, and from the weight, if made strong. Nor have I ever heard of an instance verified by other testimony than that of the inventor, of a speedy and agreeable voyage having been performed in a steamboat of any construction."

In 1786, when Evans applied to the legislature of Pennsylvania, for an exclusive right to move land-carriages by steam, "they conceived me to be deranged," says he, "because I spoke of what they thought impossible, and they refused to grant the privilege I prayed for." The authorities of Maryland, to whom he next applied, with more wisdom than their neighbors, granted his petition, on the principle that what he asked for could injure no man, and might cause him to produce something useful." But with all his perseverance, his reputation for practical knowledge, and his privilege to boot, Evans could not persuade any person of substance to think so favorably of his steam-waggon, as to furnish him with the means to try one on a common road. And the drawings and descriptions of his scheme which he sent to England, to find a patron there, produced no better result.

The history of the result of another attempt to navigate by steam, which was made in Scotland, by Mr. Patrick Miller, of Dalswinton, has been lately given to the public by his son.* Mr. Miller, in 1787, had published a description and drawings of a triple vessel, moved with wheels, and gave a short account of the properties and advantages of the invention. "In the course of his explanations, he suggested that the power of a steam-engine may be applied to move the wheels so as to give them a quicker motion, and consequently to increase that of the ship. It may readily be believed, that this hint of his intention to apply the power of steam to the wheels of his double and triple vessels was not hastily thrown out. In the course of his various experiments on the comparative velocity of his vessels, with those propelled by sails, or by ordinary oars, which had given occasion to several interesting and animating contests for superiority, he had strongly felt the necessity of employing a higher force than that of the human arm, aided as it might be by the ordinary mechanical contrivances; and in this view, various suggestions were successively adopted, and

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"A short narrative of facts relative to the invention and practice of steam-navigation, by the late Patrick Miller, Esq., of Dalswinton, drawn up by his eldest son."—[Edinburgh Philosophical Journal, 1824.]

in their turn laid aside. Thus, at one time, it occurred to him that the power of horses might be usefully employed; while, at another, the aid of wind itself seemed to furnish the means of counteracting its own direct and ordinary operation. But among all the possible varieties of force, that of steam presented itself to his mind, as at once the most potent, the most certain, and the most manageable."

"In Miller's family there was at this time, as tutor to his younger children, Mr. James Taylor, who had bestowed much attention on the steam-engine, and who was in the custom of assisting Miller in his experiments on naval architecture, and the sailing of boats.* One day, in the very heat of a keen and breathless contest, in which they were engaged with a boat on the Leith establishment, this individual called out to his patron, 'that they only wanted the assistance of a steam-engine to beat their opponents;' for the power of the wheels did not move the boat faster than five miles per hour. This was not lost on Miller, and it led to many discussions on the subject; and it was under very confident belief in its success, that the allusion was made to it in the book already mentioned.

"In making his first experiments, Miller deemed it advisable, in every point of view, to begin upon a small scale; yet a scale quite sufficient to determine the problem which it was his object to solve. He had constructed a very handsome double vessel, with wheels, to be used as a pleasure boat on his lake at Dalswinton, and in this little vessel he resolved to try the application of steam." On looking round for a practical engineer to execute the work, Taylor recommended a Mr. William Symington to his attention, whom he had known at school, and who had recently contrived a mode of applying the force of steam to wheel carriages; and he accompanied Miller to the house of a Mr. Gilbert Meason, in Edinburgh, to see the model. Pleased with this specimen of Symington's ingenuity, he employed him, in conjunction with his friend Taylor, to superintend the construction of a small steam-engine, to work a double or twin boat. And in the autumn of the same year, the engine, which had brass cylinders of four inches in diameter, was fixed in the pleasure-boat on Dalswinton Loch. "Nothing could be more gratifying or complete than the success of this first trial, and while for several weeks it continued to delight Miller and his numerous visiters, it afforded him the fullest assurance of the justness of his own anticipation, of the possibility of applying to the propulsion of his vessels the unlimitable power of steam. On the approach of winter, the apparatus was removed from the boat and placed as a sort of trophy in his library at Dalswinton, and is still preserved by his family as a monument of the earliest instance of actual navigation by steam" in Great Britain.

Symington, in the succeeding year, was again commissioned by his patron to try the experiment on a greater scale; a double vessel, sixty feet long, was to be fitted with an engine and revolving paddles, suited to the supposed exigencies of the case. The engine and machinery were constructed at Carron, and in the course of six months the vessel was ready to be put in motion. In December, 1789, it was taken into the Forth and Clyde Canal, and in the presence of a vast number of spectators, the machinery was put in motion. "This second trial promised to be every way as prosperous as the first. It happened, unluckily, however, that the revolving paddles had not been made of sufficient strength, and when they were brought into full action, several of the float-boards were carried away, and a very vexatious stop was, for that day, put to the voyage. The damage was repaired, and on the 25th of December the steamboat was again put in motion, and carried along the canal at the rate of seven miles an hour, without any untoward accident, although it appeared evident that the weight of the engine was an overburden for the vessel, (her planking being only three quarters of an inch thick,) and that under such a strain it would have been imprudent to venture to sea. The experiment, however, was again repeated on the two following days; and having thus satisfied himself of the practicability of his scheme, he gave orders for unshipping the apparatus, and laying it up in the storehouses of the Carron Company."

"It may naturally occasion surprise and disappointment," continues his son, "that I should have to terminate here this account of my father's experiments on steam navigation; that he did not follow up these prosperous and decisive trials of its efficacy,

* Mr. Miller, at various periods of his life, had embarked in many great schemes of improvement, and, among others, had expended large sums in experiments on the improvement of artillery and naval architecture. It was in the course of his speculations and experiments on the latter subject, that he was led to think of devising some mode of constructing or propelling vessels in circumstances where the ordinary resources of the nautical art were insufficient or unavailing; among these, the construction of double and triple vessels, to be moved by wheels placed in proper situations, had occurred to him, as calculated to prove of essential service, and he accordingly built and equipped several vessels of this description.

with the same spirit and perseverance, which had been so conspicuous in many other instances, must for ever be matter of regret to his family, as it was to himself in the latter years of his life." The fact, however, was, "that he had to complain of the enormous expense in which he had been involved; and I may be permitted to add," continues his son, "that by this time my father, in the prosecution of his various schemes of a purely public nature, and without the slightest chance or expectation of reimbursement, had expended upwards of thirty thousand pounds." And, being by this time ardently engaged in agricultural pursuits, his attention was more easily turned from the objects of his former speculations, than those acquainted with his character would have been prepared to anticipate.

"Be that as it may, it cannot be anticipated that in point of fact he had fully established the practicability of propelling vessels of any size, by means of wheels or revolving paddles, and of adapting to these the powers of the steam engine, although, in the subordinate details of execution, great room remained for minor improvements.

"Of my father's peculiar and undoubted merits as an inventor, I have," continues his son, with a pardonable partiality, "endeavored to give a fair and unvarnished account; and of the reality of that invention, as carried into actual practice in the years 1788 and 1789, no demonstration more unequivocal can be desired than that, with his few but most satisfactory experiments, the prosecution of this momentous discovery remained suspended for many years, in a state of inactivity and neglect, till, at a period comparatively recent, it was revived in America, and in this country, by persons who can be proved to have derived their first lights from the experiments at Dalswinton and at Carron. But I have felt no other desire than to record the facts immediately connected with my father's operations, and to establish the priority of his claims to the credit of having originated, and carried into practical execution, an improvement in the nautical art, by far the most important of which the present age has to boast; and the ultimate effects of which, on the future intercourse of mankind, the most sanguine imagination would attempt in vain to predict."

The narrative which Mr. Miller gave of his father's attempt to construct a steamboat, and from which we have made some copious extracts, agrees with an account of the same experiments which was given in a sketch of navigation by steam, inserted in the Supplement to the Encyclopedia Britannica.

Symington, who appears to have been more sanguine than his first patron, of the practicability of navigating vessels by steam, nearly twelve years after his experiments at Dalswinton Loch, found an opportunity to bring his scheme under the notice of a nobleman, who was zealous to encourage projects which had for their object the improvement of inland navigation. Symington, who imagined that a boat moved by wheels could be introduced with great economy, as a substitute for horses, in towing boats on canals, succeeded in inducing Lord Dundas, of Kerse, to assist him to make an experiment, on a great scale, on the Forth and Clyde Canal, with machinery, resembling in its principle that of the Dalswinton model, but modified to suit the purpose which he had more immediately in contemplation.

The result of this application, and the character of his patron, may here be noticed with reference to Symington on another account, besides its connection with a history of his experiment. From an expression in Miller's narrative, that his father was discouraged from proceeding farther from a feeling of disgust at having been involved in unnecessary expenses, an inference might be drawn unfavorable to the memory of an ingenious and worthy man.

But Miller's complaint is, in truth, a very common one; and the estimates even of the most experienced mechanics will probably continue to differ widely from the final outlay, even although those artists have been experimenting on their own means.

"Mr. Miller," says Symington, in his narrative, "being very much engaged in improving his estate in Dumfriesshire, and I also employed in constructing large machinery, for the lead mines at Wanlockhead, the idea of carrying the experiments at that time any further was entirely given up, till meeting with the late Thomas Lord Dundas, of Kerse, who wished that I would construct a steamboat for dragging vessels on the Forth and Clyde Canal, instead of horses. Agreeably to his Lordship's request, a series of experiments, which cost nearly three thousand pounds, were set on foot in 1801, and ending in 1802, upon a larger scale (than those on Dalswinton Loch) and more improved plan, having a steam cylinder twenty-two inches diameter, and four feet stroke, which proved itself very much adapted for the intended purposes. Having previously made various experiments in March, 1802, on the Forth and Clyde Canal, Lord Dundas and several other gentlemen being on board, the steam packet took in tow two loaded vessels, each of seventy tons burden,

and moved with great ease through the canal, a distance of nineteen and a half miles in six hours, although the whole time it blew a strong breeze right a-head of us, so much so, that no other vessels could move to windward in the canal that day but those we had in tow, which put beyond the possibility of a doubt the utility of the scheme in canals and rivers, and ultimately in open seas. Though in this state of forwardness, it was opposed by some narrow-minded proprietors of the canal, under a very mistaken idea that the undulation of the water, occasioned by the motion of the wheel, would wash and injure its banks. In consequence, it was with great reluctance laid up in a creek of the canal, exposed for years to public view, where Henry Bell from Glasgow, who also frequently inspected the steamboat at Carron, in 1789, did also particularly examine this."

During the time that he was engaged in this experiment, Symington received a visit from a Mr. Fulton, " who," says he, " politely made himself known, and candidly told me he was lately from North America, and intended to return thither in a few months; but having heard of our steamboat operations, he could not think of leaving the country without first waiting upon me, in expectation of seeing the boat, and procuring such information regarding it as I might be pleased to communicate. He at the same time mentioned, however advantageous such an invention might be to Great Britain, it would certainly be more so to North America, on account of the many extensive navigable rivers in that country. And as timber of the first quality for building the vessels, as also for fuel to the engines, could be purchased there at a small expense, he was decidedly of opinion it could hardly fail, in a few years, to become very beneficial to trade in that part of the world; and that his carrying the plan to North America could not turn out otherwise than to my advantage, as if I were inclined to do it, both the making and superintending of such vessels would naturally fall upon me, provided my engagements with steamboats at home did not occupy so much of my time, as to prevent me from paying any attention to those which might afterwards be constructed abroad. In compliance with his earnest request, I caused the engine fire to be lighted up, and in a short time thereafter put the steamboat in motion, and carrying him four miles on the canal, returned to the place of starting, to the great astonishment of Fulton and several gentlemen, who at our request came on board. During the above trip, Fulton asked me, 'if I had any objections to his taking notes respecting the steamboat?' to which question, I said 'none;' and after putting several pointed questions respecting the general construction and effect of the machine, which I answered in a most explicit manner, he jotted down, particularly, every thing then described, with his own remarks upon the boat;" "but he seems," says Symington, "to have been altogether forgetful of this, as, notwithstanding his fair promises, I never heard any thing more of him till reading in a newspaper an account of his death."

From these facts, the author of the sketch thinks it is very evident Symington was the first person who had the merit of *successfully* applying the power of the steam engine to the propulsion of vessels, and that there can be but one opinion, that, in its influence on the fate of a most ingenious man, there existed not enterprise enough in Scotland to encourage this excellent artisan to repeat his interesting and important experiments on the river Clyde.

About the time Symington had abandoned his experiments, M. Des Blanc, a watchmaker at Trevoux, had built a steamboat, and made some experiments with it on the river Soane. The first attempts were so successful as to bring forth the Marquis de Jouffroi, with his prior claim; the final result, however, was as hapless as the Marquis's.

Although we insert this statement from an English work, we by no means wish it understood we adopt their opinions. We think otherwise: at all events, our columns are open to all claimants or their friends.

The persevering and ingenious Evans, of Pennsylvania, found that, in an engine working ten saws, when it was put in motion with steam of the elasticity to drive one saw only, and suffer the piston to move briskly, the steam was carried off from the boiler as fast as it was generated, and fuel consumed and time spent to little purpose; but when the steam was confined, and retained in the boiler until it lifts the safety valve with a power sufficient to drive ten saws, it will do that work all day, and consume but little more fuel; and if the working cylinder be eight inches in diameter, it will drive a pair of five feet mill-stones.

This engine, as described, it will be seen, deviates little from the condensing engine of Watt, except in the boiler, the form of which is excellent. One of his first boilers was a cast-iron cylinder, twenty inches in diameter, and twenty feet long, cased on the outside with wood. In other cases, he made the

fire surround the cylinder, and inclosed the flue by brick work.

His boilers were made strong enough by estimation to bear a pressure of 1500 pounds on each square inch, but he generally worked with a pressure of from fifty to one hundred pounds on the square inch. He thought, in comparing the economy of using steam at this high temperature, in an engine without a condenser, with that from 212° to 220° used with a condenser, that, by doubling the fuel, he produced sixteen times the effect. The water was supplied to the boiler by a small forcing pump: he experienced great loss of power, by using cold water as a supply, "for although it lowers the heat but little, yet as it has been shown that a small increase of heat, 30°, doubles the power, so an equal decrease reduces it a half, from one hundred and twenty pounds to sixty pounds' pressure." (p. 37.) Evans therefore used a second or supply boiler, the water of which was heated either by the steam which escaped from the cylinder, or by passing the flue of the furnace under it; as we may suppose that cold water receives heat more freely than hot, he sometimes made his boiler in several parts, passing the flue of the furnace through them all, and forcing the supply of water into that part furthest from the fire, to pass from the one to the other, by small connecting pipes meeting the fire.—[Young Steam Engineer's Guide, p. 49.]

Evans also worked his engines with steam used expansively, and this was probably their most economical application; he raised the temperature of the vapor, to make its elasticity equal to 120 pounds on each square inch, and shut off its entrance into the cylinder when the piston had made a part of its stroke, as practised by Watt and others, with steam of the common temperature. "Thus the piston is driven by strong puffs of steam, the same as an air-gun drives its bullets, with this difference, the air-gun is soon exhausted, but the fire keeps up the power of the steam; the whole power of the steam is expended on the piston before it leaves the cylinder, except what is necessary to resist the atmosphere."

This engine, however, will not bear a comparison with that of Trevithick and Vivian. But the practice of Evans, and his publication on the subject, the first which was professedly of a practical nature, has produced a general impression in favor of using steam of a high temperature in North America; and by thus dispelling the vulgar prejudice which still exists against its use in England, the foundation has been laid for the introduction of improvement, on a principle which is yet thought to be capable of a great and beneficial extension."

Evans, too, had rivals to dispute even his secondary claims to invention. A Mr. John Stevens, of Hoboken, near New-York, had been making experiments to apply steam of a high temperature, by generating it in a boiler formed of small copper tubes, each about one inch in diameter and two feet long, inserted at each end into a brass plate; these plates were closed at each end of the pipes by a strong cap of cast iron or brass, leaving the space of an inch or two between the plates. The necessary supply of water was injected by means of a forcing pump at one end, through a tube inserted at the other end; one of these boilers, six feet long, two feet deep, and four feet wide, exposed four hundred feet of surface in the most advantageous manner to the action of the fire. Stevens said his object was to form a machine adapted more immediately to the propelling of a boat. "He tried a rotary engine, on the axis of which revolved a wheel at the stern of the boat, like a wind-mill or smoke-jack, but he found it impossible to preserve a sufficient degree of tightness in the packing; a second modification of his rotary apparatus, on trial, proved no better than the first. At last he had recourse to Watt's engine, with a cylinder 4½ inches in diameter and a nine inch stroke; the beam was omitted; the boiler, two feet long, fifteen inches wide, twelve inches high, consisted of eighty-one tubes, each an inch in diameter; his boat was twenty-five feet long and five feet wide. This was tried in May, 1804, and had a velocity of four miles an hour; after having made repeated trials with her, his son undertook to cross from Hoboken to New-York, when unfortunately, as the boat nearly reached the wharf, the steam-pipe gave way, having been put on with soft solder. This boiler being damaged, the next one was constructed with the tubes placed vertically. The engine was kept going for a fortnight or three weeks, the boat making excursions of two or three miles up and down the river; for a short distance he could make it sail at a rate of not less than seven or eight miles an hour."*

In the same year, his rival constructed, for the Board of Health in Philadelphia, a machine for cleaning docks. Evans, who was a clever man with a plain name, considering that a sounding cognomen would do no harm to a simple machine, christened his mud-scraper the Orukter Amphibolos. This

* Col. Stevens took out a patent for his boiler in England, in 1805.

was a heavy flat-bottomed boat, thirty feet long, and twelve feet broad, with a chain of buckets to bring up the mud, and hooks to clear away sticks, stones, and other obstacles. A small steam-engine was placed in the boat to work the buckets, having a cylinder five inches in diameter, and a stroke of nineteen inches. "It was constructed one mile and a half from the river Schuylkill; the boat was mounted on wheels, which were moved by the engine; the whole, weighing about 42,000 pounds, was moved with a gentle motion up Market street, in Philadelphia, and around the Centre Square; and he concluded from the experiment, that the engine was able to rise any ascent allowed by law on turnpike roads, which is not more than four degrees; and when the Orukter Amphibolos was launched, he fixed a simple wheel at her stern to propel her through the water by the engine; she drew nineteen inches of water; and he inferred, that is the power had been applied to give the paddle wheel the proper motion, he could have stemmed the tide of the Delaware."

Stevens went no further with his experiment, and Evans also stopped with this exhibition; in discussing their claims, Evans declared that he had spent two thousand dollars on his project; Stevens lamented that he had been "twenty years of his life on his, and spent twenty thousand dollars, without deriving a shilling benefit." Stevens thought some of Evans' projects were absurd: Evans retorted, "that the colonel's setting himself up as an obstacle to his improvements, had done more to perpetuate his (the colonel's) memory than his twenty years' hard work, and the loss of twenty thousand dollars." Be that as it may, although in their lives their schemes were opposed, our respect for their memories shall not be divided, and they shall together enjoy that immortality which our book, we hope, will confer upon them.

This Col. Stevens still is alive, and is respected by all who have the honor of his acquaintance.

We have much pleasure in inserting the following report from Congress:

STEAM BOILERS.—The select committee of Congress, to whom was referred the memorial of Benjamin Phillips, of Philadelphia, have made the following report:

The object of the memorialist is to invite the attention of Congress, and of the public generally, to certain improvements devised by him in the use and structure of the steam engine. The model of his apparatus, accompanied by drawings and diagrams, illustrative of its principles, have been submitted and examined. Whatever other advantages may be supposed to be combined in the scheme, the committee have considered it chiefly, if not exclusively, in reference to its comparative safety, or exemption from the danger of explosion.

It seems to be a point conceded by scientific observers, that among the primary causes of explosion in steam boilers, one of the most prominent may be traced to the want of a constant and regular supply of water while the engine is in action. The usual means employed, as the committee are advised, both for supplying the consumption of the boiler and for ascertaining the quantum of water in that receptacle, are inadequate and uncertain. The forcing pump is liable to derangement; and when the water has fallen so low as to superinduce the circumstances of danger, neither the common cock, nor the common safety valve, can be relied on for an accurate indication of the state of things so essential to be known. By the plan submitted, these defects appear to be remedied. A constant and uniform supply of water, and a test water gauge, indicating to the eye, at any moment, the precise level of the fluid in the boiler, form a part of the melioration suggested.

But what appears to the committee to be the most distinguished feature of the plan, that it contemplates the employment of the steam at any given pressure, without a corresponding stress on the boiler. This result is obtained by generating the steam at a very moderate pressure on the boiler, from whence it is conveyed for use, to one or more receivers, in which, before it is applied as the momentum to the engine, it may be raised, by flues heated from a separate furnace, to any required degree of elasticity.

The committee are of opinion, that if it be feasible, of which they do not doubt, it must of itself be an important step towards the grand desideratum. Confined in a separate reservoir, not in immediate connection with the boiler, the steam, however rarified, would not be liable to be suddenly injected with water, a process which all concurring experience proclaims to be the proximate cause of many of the most dreadful accidents that have occurred.

The form and position of the contemplated receiver is believed to present another condition of security. Placed vertically on the deck, with chambers or compartments connected by valves, the steam at its greatest tension naturally rushing through the

valves into the upper chambers of the recipient, if ever explosion should take place, it would be a mere effusion of steam, and not of heated water; and the discharge would be upwards, into the open air, leaving untouched the passengers and the property embarked in the vessel.

There are other particulars in the mechanism, of the usefulness of which practical engineers alone are competent to form an accurate estimate. It will suffice to say, that, as a whole, the committee consider the contrivance as reflecting credit on the science and ingenuity of the proprietor, and that his plan is worthy of a full and fair experiment.

On the question as to the power and the expediency of aid and co-operation on the part of government in experiments of this kind, the committee have come to an affirmative conclusion. When it is considered how intimately the subject matter connects itself with the general welfare, looking to the protection of the lives and property of the whole people, that it involves considerations of naval and national defence, as well as the general interests of commerce, it is not thought that any valid opposing argument can be drawn from the want of power, much less can an objection be raised on the score of policy.

The committee have thought proper to recommend a small sum to be placed at the disposal of the Secretary of the Navy, to test the improvements of this branch. It is believed that a reasonable expenditure of the public money for this subject would coincide with the universal sense, and meet the applause of the nation. The knowledge of the mode of controlling and directing with safety this powerful, but hitherto dangerous, agent in the affairs of men, would be cheaply purchased at the cost of millions.

We most sincerely hope that the provisions of the following law may be enacted in every State in the Union—it would, we think, be an effectual check to the careless manner in which some of our steam engines are looked after.

STEAMBOAT LAW.—Louisiana has been the first state to set the example of vigorous legislation for the prevention and punishment of negligence in the navigation and management of steamboats. For the synopsis of the law which she has made on that subject, we are indebted to the Baltimore American, as follows:—[Nat. Intel.]

The Legislature of Louisiana, which has just adjourned, adopted a very severe, and, we trust, efficient law, for the regulation of steamboats, so as to secure them from explosion. The number of fatal accidents on the Mississippi, particularly the disastrous one by which Senator Johnston lost his life, imperiously called for some legislative interference, to secure care and fidelity in the management of engines, and every practical assurance of their soundness. The new law manifests great anxiety to establish minute precautions against accident, as well as misconduct; and imposes heavy penalties on the agents and owners in every case of damage which any possible care might have prevented. To make the law more effective, it has been sent to the Executives of all the States bordering on the Mississippi, and its tributaries, for similar action.

The law establishes the office of State Engineer for the port of New-Orleans. The duty of the Engineer is to examine once in three months the strength of the boilers of steamboats plying within the waters of the state; to test them by hydraulic pressure to *three* times the weight of steam they may be supposed capable of carrying; and to furnish each boat with a certificate, specifying the weight of steam which may be safely used.

In case any accident happens on board of any boat not possessing the proper certificates, neither captain, owner, or agent, can recover any claim for freight or insurance; the owner or agent is made responsible to the shipper, to the full amount of all damage; and the captain is further subjected to a fine, not less than $500, nor more than $2000, and to imprisonment for not less than three months, nor more than three years. If lives are lost, the captain is to be adjudged guilty of manslaughter. The same penalties to the several parties are provided in case of any accident in navigation, from overloading, racing, carrying higher steam than the certificate allows, or any accident "that may occur while the captain, pilot, or engineer, is engaged in gambling, or attending to any game of chance or hazard."

The same penalties are provided in case of any accident from gunpowder, shipped without a written notice of the fact being posted in three conspicuous parts of the boat.

Shippers are made liable to a fine of two hundred dollars for shipping gunpowder, without notice to the master's clerk; and also made liable for damages that may happen by any accident therefrom; and in case of loss of ife, are adjudged guilty of manslaughter.

In passing, on the river, the descending boat is commanded to shut off steam and float down, when within a mile of an ascending boat—the latter to assume the responsibility of steering clear of the other, and being liable for all damages.

Other minute directions are given, but the above form the principal enactments of the law, which appear to be drawn up with a determination to enforce rigorous penalties against any carelessness in the management of steam engines on the Mississippi, within the limits of the State of Louisiana.

It is known that we have been much censured on this subject. The following is from a London paper:

BROTHER JONATHAN AT FAULT.—The Americans either cannot or will not make their steam-boilers so secure as the English; a fact proved by the accounts in the United States' papers of twelve fatal steamboat accidents in the short space of six weeks, and the recommendation by the President of a new law upon the subject. This must surely be a puzzling fact for those sneerers at "over legislation," who maintain that the public are quite able and quite willing to take sufficient care of themselves in such matters, without the *officious interference* of parliaments.

MR. BETHUNE'S STEAMER.—We have examined the model of the boat now placed at the Exchange. It resembles, in the build of its hull, Mr. Burden's boat: but instead of two barrels, it has *three*, and the wheels revolve on each side of the middle barrel. The draft of water is very little, and undoubtedly the speed of the boat would be great. It has also some advantages over the other boats, in the arrangements above deck, offering a covered walk of 412 feet, &c. Upon the whole, Mr. Bethune's exertions deserve encouragement, and may lead to some real improvements. With the present overdone business in steamers, and the general depression of trade, it could hardly be expected that large investments would be made in a new scheme of this kind. What we want most, and what might afford some prospect of success, would be small boats, built as cheaply as possible, *for passengers alone*, and having great speed. Such improved boats run in several parts of Great Britain, and particularly on the Clyde in Scotland. Under present circumstances, such a speculation would also be very uncertain. But ultimately, our *freight and passage* steamers must be replaced by those for passage only; without, indeed, railroads take the place of all descriptions of water carriage, the latter being certainly less rapid and more expensive.

We copy Mr. Bethune's own statement of the dimensions and properties of his model:

Dimensions of the Model.—(Scale, $\frac{1}{4}$ inch to a foot.)—Centre tube, length 220 feet, side tubes, ed. 190, diameter 12 feet ed. at centre, and 2 feet at the ends; extreme length on deck, 244 feet; extreme breadth in centre, 72 feet; lower cabin, length 192 feet, centre breadth of the same 52, stern breadth 37; upper cabin, length 182, centre breadth 40, stern do. 29; height of both cabins, $7\frac{1}{2}$ feet; lower wings on deck, 10 feet, outside of cabin; fender outside of tubes, 5 feet on each side; upper piazza, breadth 8 feet, circumference or length of walk round which is 412 feet; promenade deck, length 194 feet; spaces between the tubes, 13 feet; proposed diameter of two water wheels, 27 feet; total weight of the three tubes, superstructure, and two engines of 50 horse power each, on board, $275\frac{1}{2}$ tons, which will displace 9875 cubic feet of water. Draught of water, when light, 3 feet 9 inches; do. with 1500 passengers on board, 4 feet 6 inches. Cargo required to sink the tubes to their centre, or to six feet draught of water, 336 tons.—[Quebec Gazette.]

STEAM-DIGGING MACHINE.—M. Wronski, a celebrated mathematician at Paris, has, according to the Paris papers, discovered a new system of applying steam to carriages, digging machines, hoes, picks, ploughs, &c. so superior to any thing hitherto known, that a French company has bought his patent for four millions of francs.—[Le Temps.]

Numerous have been the conjectures respecting the first discovery of the power of steam. It is a question which we cannot decide; but an ingenious friend handed us the annexed engraving, accompanying it with his opinion, *after much research*, that it represents the first impression ever made on the human frame by steam. We insert it, and for this week must conclude.

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